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Grand Junction Area Air Quality Handbook, Draft

PEDCo-Environmental, Inc.
Kansas City, MO

Prepared for

Environmental Protection Agency
Denver, CO Region VIII

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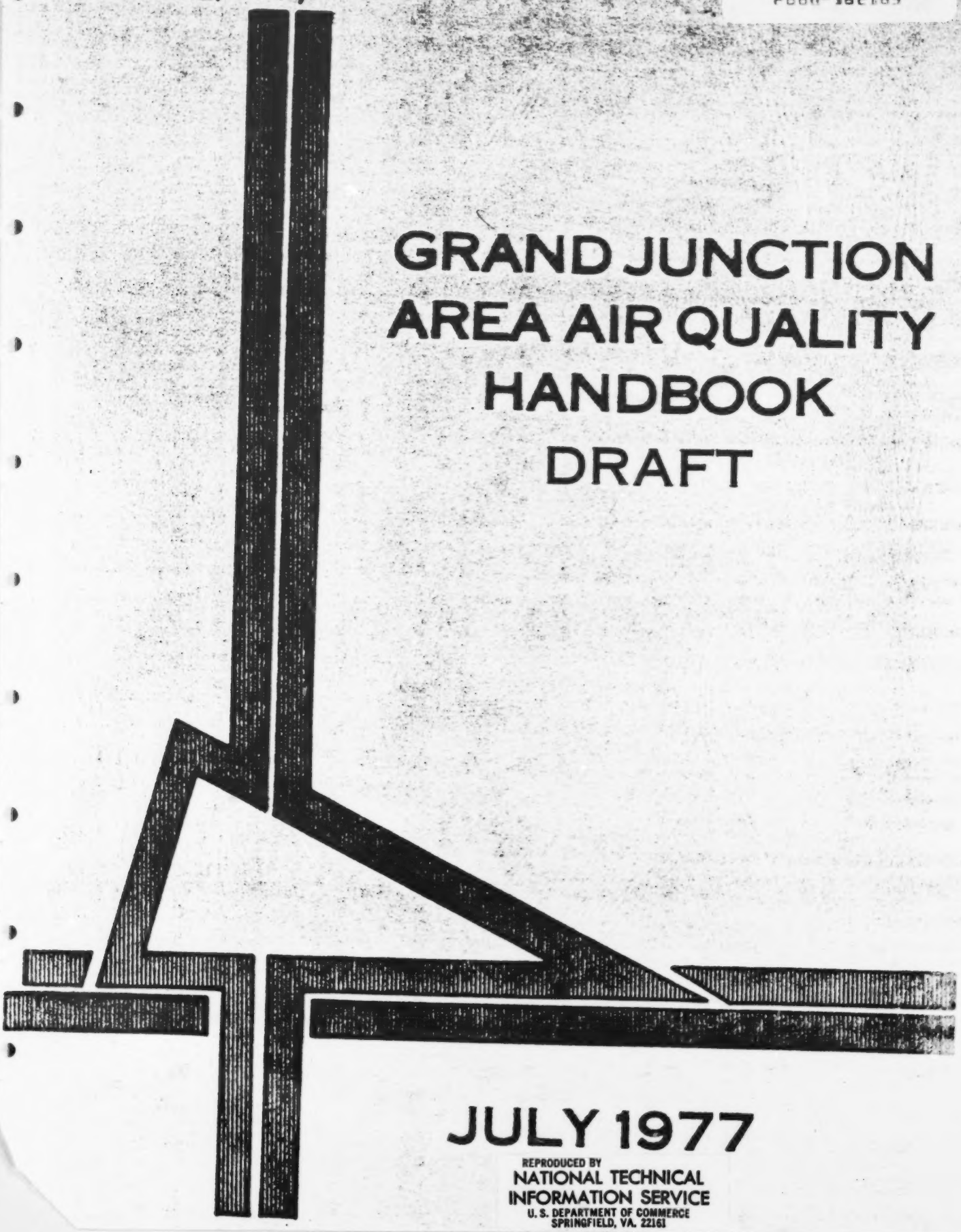
GRAND JUNCTION AREA AIR QUALITY HANDBOOK

DRAFT



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This handbook will provide members of the Grand Junction Area Subcommittee (a local advisory group) with information on particulate air quality in the Grand Junction area and identify for them the types of sources contributing to the particulate problem. This report will also be of interest to anyone seeking information on the air quality of Grand Junction.

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AIR QUALITY HANDBOOK

DRAFT

FOR DISCUSSION PURPOSES ONLY

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PURPOSE

This handbook will provide members of the Grand Junction Area Subcommittee with information on particulate air quality in the Grand Junction area and identify for them the types of sources contributing to the particulate problem. The handbook should also be helpful to anyone who is interested in the air quality of the area. The draft Northwest Colorado Air Quality Maintenance Area (AQMA) Analysis, prepared in November 1976, included the Grand Junction area in Mesa County as one analysis area. Copies of this analysis are available from the Colorado Air Pollution Control Division or the Mesa County Health Department. The information in the report, together with information from a study completed in June 1976 (see Appendix A), furnish background data for this handbook.

PROBLEM

The particulate concentrations measured in 1974 (base year) at Grand Junction and Fruita sampling sites showed the Grand Junction site to be in violation of both annual and short-term federal ambient air quality standards. From 1971 to 1976, the annual mean concentration at the Grand Junction site has exceeded the primary standard each year. Although the primary standard has not been exceeded in Fruita, the trend appears to be toward higher concentrations. For further discussion of ambient air quality standards see Appendix B.

In the AQMA analysis, a study area extending from the city of Grand Junction northwest to Fruita was selected for air pollution diffusion modeling. The purpose of the model was to predict particulate concentrations throughout the analysis area. This would provide air quality data not just for two locations but for the entire study area. Figure 1 presents a map of the study area showing model-estimated

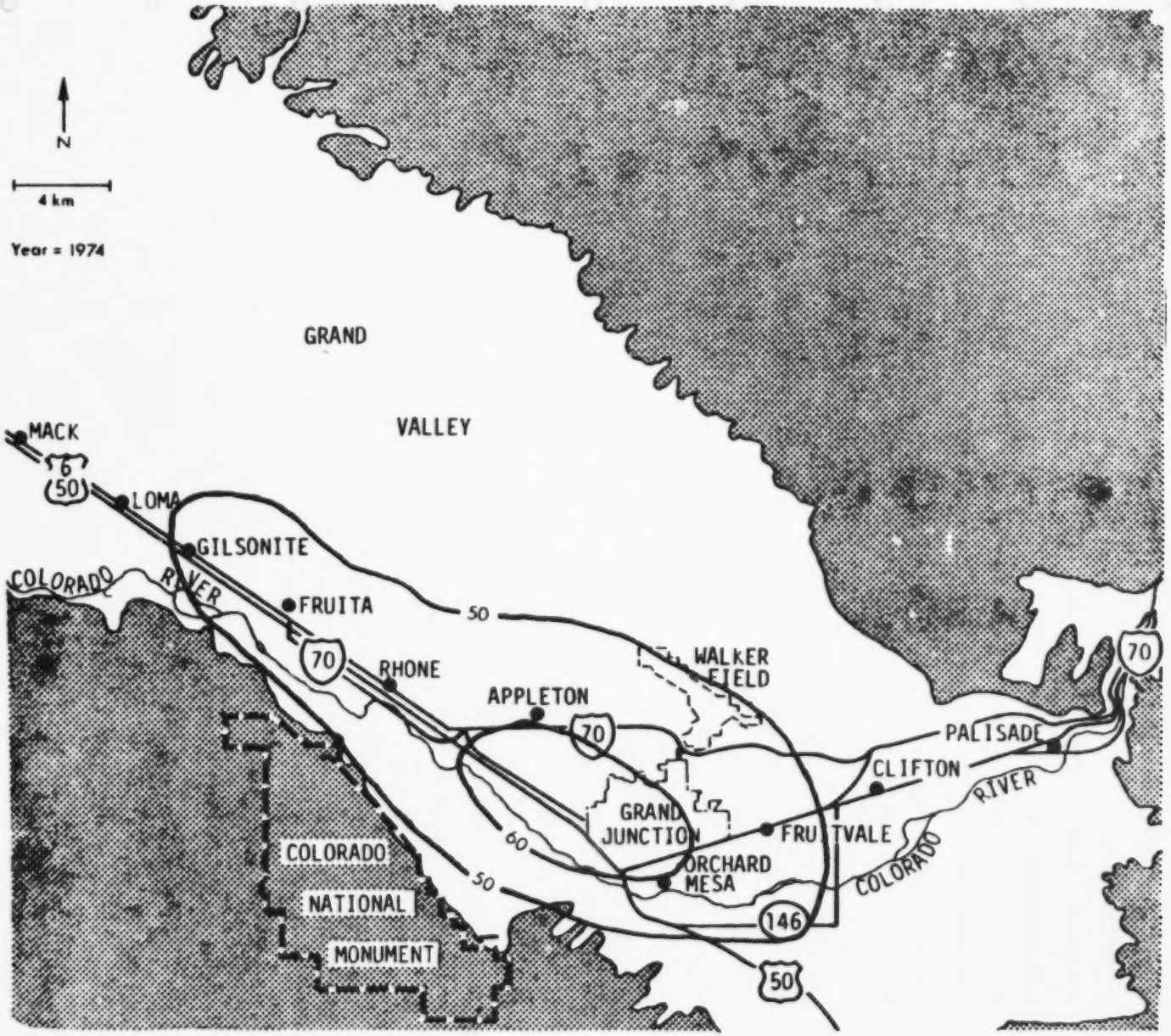


Figure 1. Grand Junction area, 1974 annual geometric mean particulate concentrations, ug/m^3.

base year particulate concentrations. Figures 2 and 3 show the projected particulate concentrations for 1980 and 1985, respectively.

The report revealed some difficulty with predicting concentrations within the city of Grand Junction, the area with the highest concentrations in the AQMA. Probable reasons for the model predicting concentrations less than the measured concentrations are: inability to estimate dust emissions from unpaved roads, from paved roads, and from construction activity; microscale meteorological variations; or localized background* variations.

The major conclusion to be drawn from the modeling effort (as illustrated in Figures 1, 2, and 3) is that future concentrations will increase from existing levels. Combined with existing concentrations above the primary standard, continued non-attainment of the ambient air quality standard is indicated.

The analysis determined the relative amount of emissions from contributing sources in the area. Table 1 (see Appendix C) presents the particulate emissions from each source category for three levels within the AQMA--all of Mesa County, the Grand Junction study area modeled in the analysis, and the high concentration area within the city of Grand Junction.

This table shows that the major contributing source category for the non-attainment area is fugitive dust and the principal subcategories are unpaved roads, reentrained dust from paved roads, and cleared areas. The overall

---

* Background concentration is that portion of measured ambient levels of particulate that cannot be reduced by controlling emissions from man-made sources. This non-reducible fraction has many identifiable origins: long-range transport; natural sources, such as dust from natural surfaces, pollen, biological debris; and aerosol formation, including sulfates, nitrates, organics.

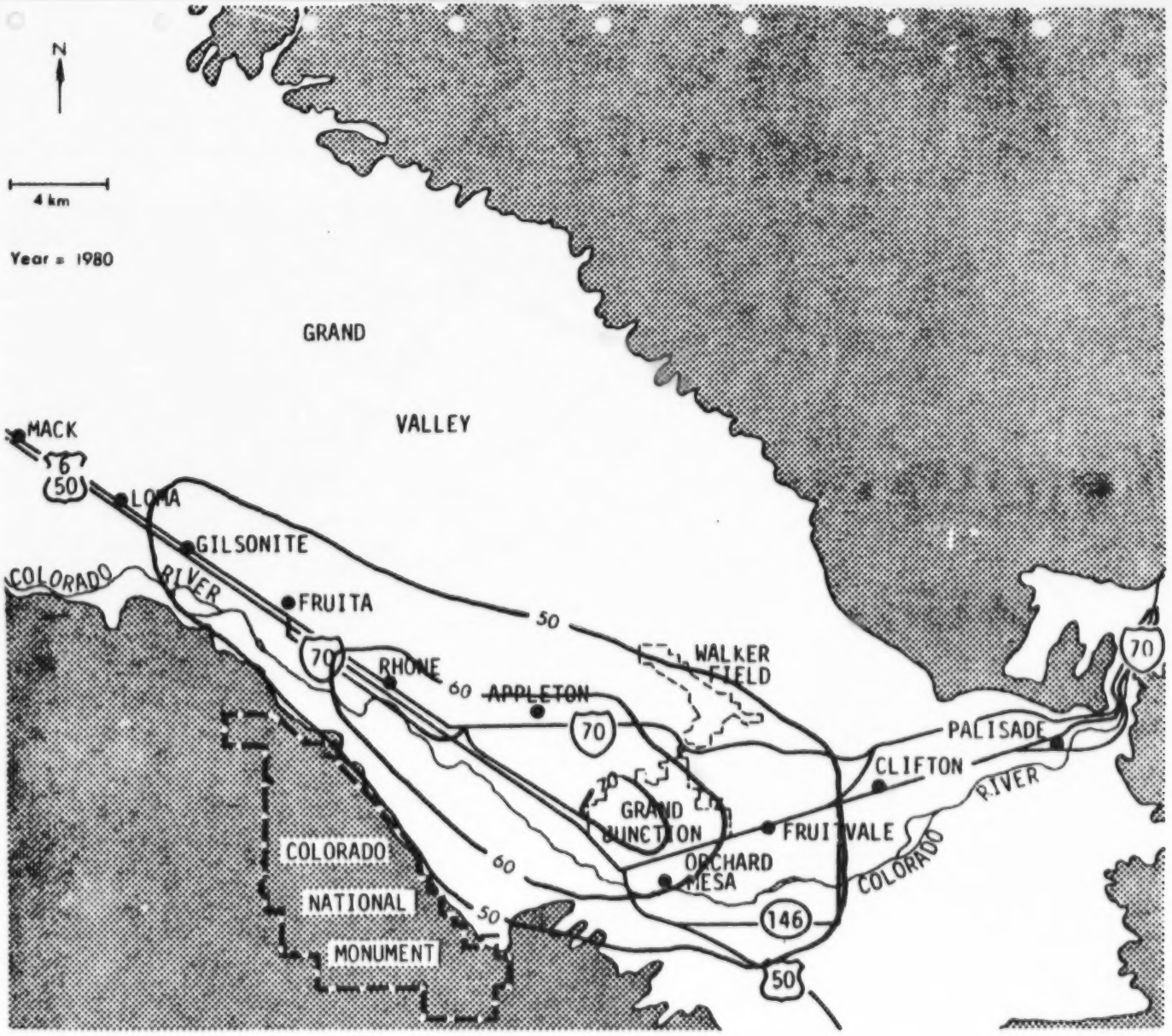


Figure 2. Grand Junction area, 1980 annual geometric mean particulate concentrations, ug/m^3.

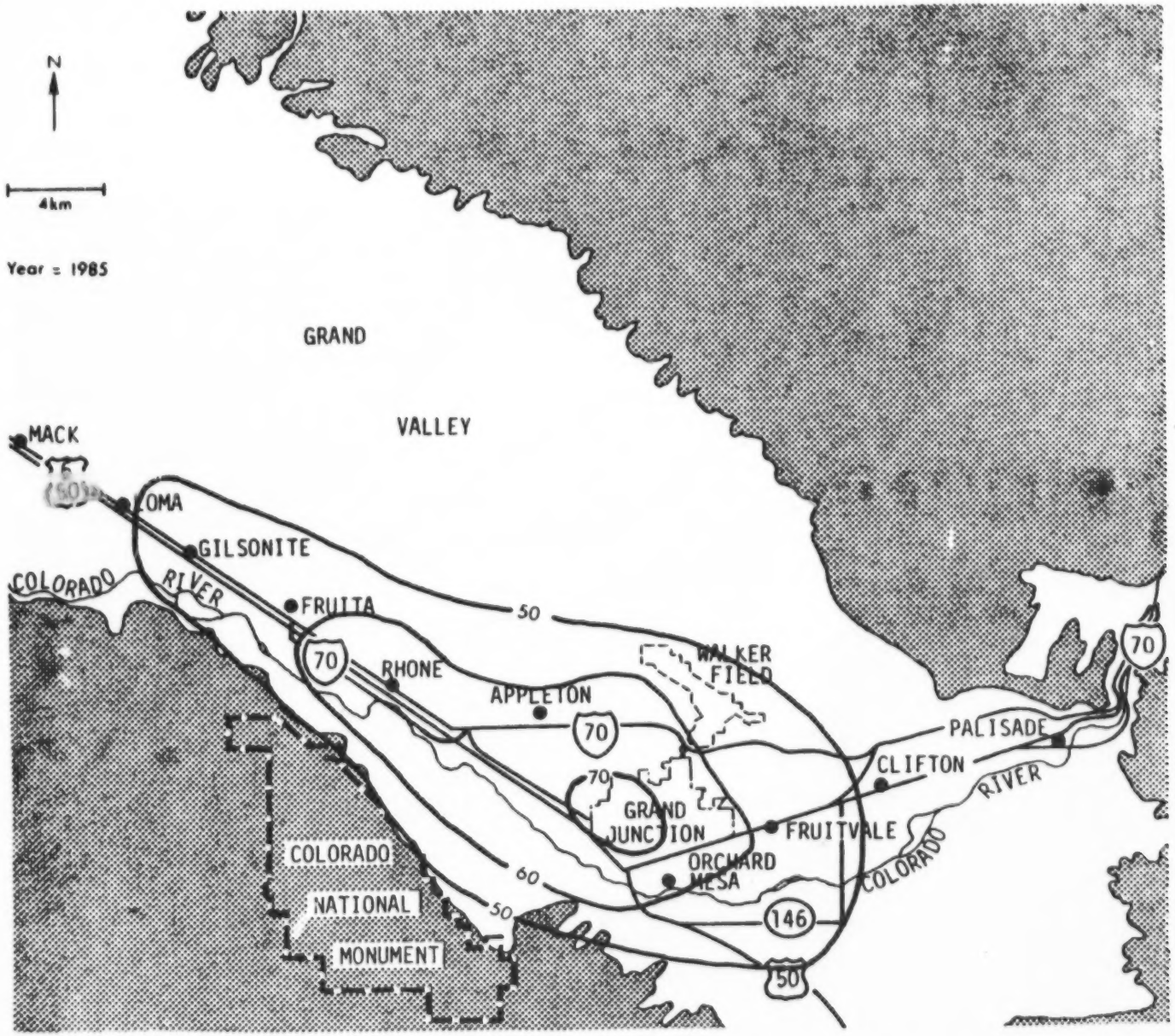


Figure 3. Grand Junction area, 1985 annual geometric mean particulate concentrations, ug/m^3.

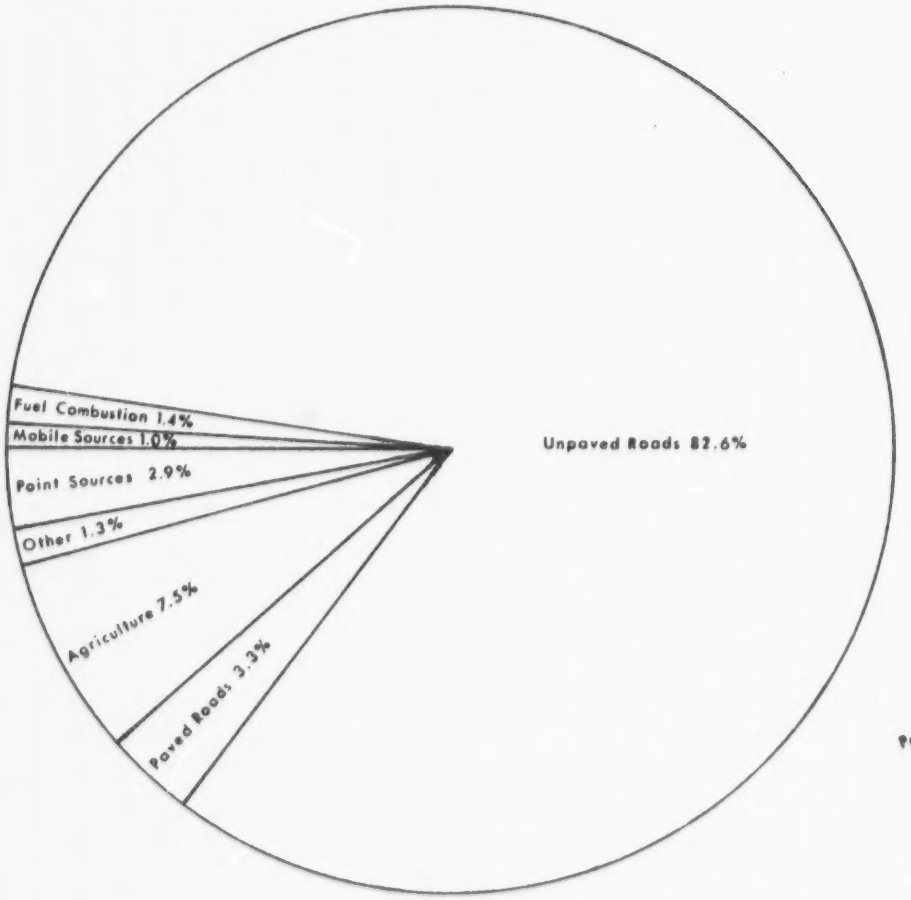
contribution of the various source categories at each level examined is more apparent in Figure 4. For example, fugitive dust represents about 87 percent of the total emissions in the non-attainment area. This identifies the primary sources that need to be addressed by the subcommittee in order to achieve the emission reductions necessary to meet ambient air quality standards. Particulate reductions from major sources should be in areas where air quality standards are currently being exceeded and where projections indicate standards will be violated.

REQUIRED REDUCTIONS

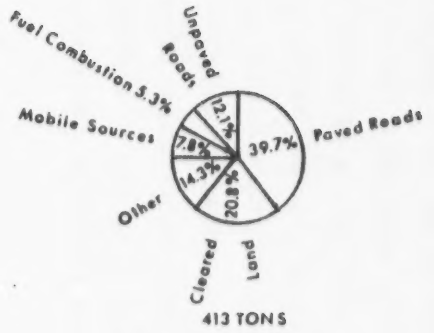
In Figure 5, both *measured* and *model-predicted* concentrations are plotted for the two sites at Grand Junction and Fruita. This figure suggests that the model underpredicted in the base year in the city of Grand Junction. Neither the AQMA analysis nor a recent detailed investigation of the sampling site (see Appendix A) satisfactorily explain the difference.

The difference between *measured* and *predicted* values has significant implications for determining the amount of emission reduction required to attain the standards. The model predicts that the primary standard is currently being met, but reductions of 33 percent (taking background into account) are required to meet the secondary standard. It further predicts that reductions of 10 and 49 percent are required to meet the primary and the secondary standard, respectively, in 1985. Using 1974 measured values, reductions of 42 and 67 percent are required simply to attain each of the standards. Larger reductions would be required in 1985. However, using 1976 measured values, reductions of only 12 and 50 percent for the respective standards are currently required. Regardless of which set of data is used, significant reductions are indicated as necessary in 1985.

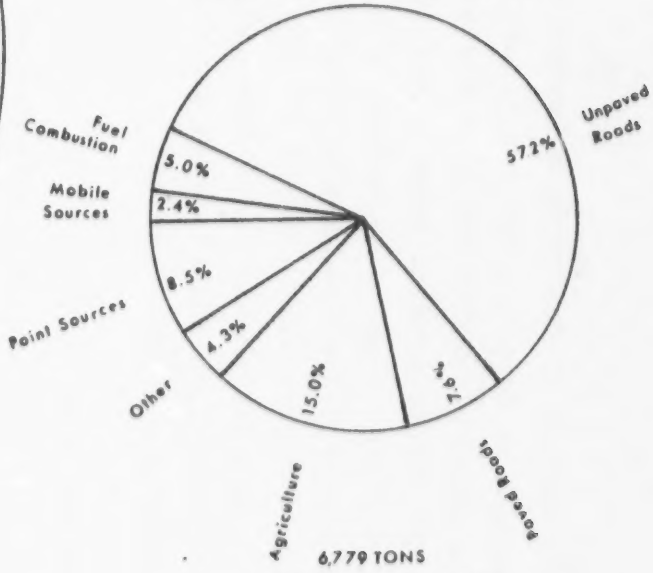
Note: Areas of circles are proportional to emissions in the three areas.



Mesa County



Grand Junction non-attainment area



Grand Junction analysis area

Figure 4. Percentages of total particulate emissions by source category for the three levels within the AQMA.

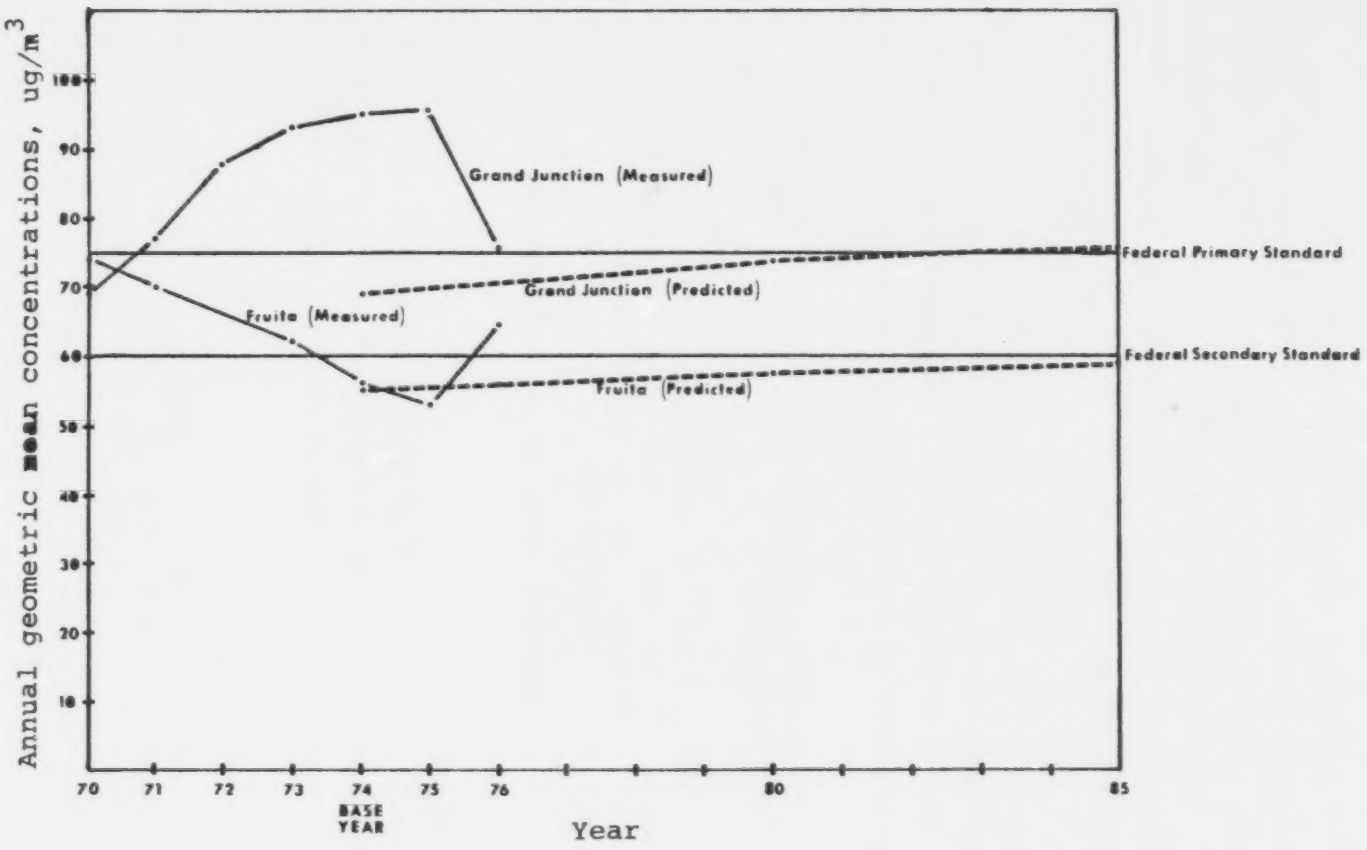


Figure 5. Measured and model-predicted particulate concentrations.

POTENTIALLY AVAILABLE CONTROL STRATEGIES

There are numerous strategies that can be applied to the control of particulate emissions from any one source category. They may vary, however, in their applicability and/or feasibility. The following information provides the subcommittee with a brief summary of these control strategies.

Agriculture

Supplement No. 5 of the emission factors handbook, prepared by the U.S. Environmental Protection Agency (EPA), addresses control of emissions from agricultural sources:

> In general, control methods are not applied to reduce emissions from agricultural tilling. Irrigation of fields prior to plowing will reduce emissions but in many cases this practice would make the soil unworkable and adversely affect the plowed soil's characteristics. Control methods for agricultural activities are aimed primarily at reduction of emissions from wind erosion through such practices as continuous cropping, stubble mulching, strip cropping, limited irrigation of fallow fields, windbreaks, and use of chemical stabilizers.

Transportation

Controlling reentrained dust from paved roads is a relatively newer approach to reducing particulate concentrations. Six different general techniques have been identified:

- improved street cleaning (which would involve combining sweepers and flushers, concentrating sweeping on heavily travelled roads, sweeping during the winter, improved operator training, or prohibition of on-street parking during sweeping);
- control of construction-related mud runoff and trackout;
- control of other sources of runoff or trackout;

- modifying street sanding procedures,
- reduction of vehicle miles travelled (VMT); and
- stricter enforcement of vehicle visible emission limitations.

The control efficiency of these techniques may vary from one situation to another; however, available information shows that reduction of VMT would have the greatest effect, followed by control of trackout, modification of sanding practices, and improved street cleaning.

Information from EPA on control effectiveness for unpaved roads states that:

> Common control techniques for unpaved roads are paving, surface treatment with penetration chemicals, working of soil stabilization chemicals into the roadbed, watering, and traffic control regulations. Paving as a control technique is often not practical due to high cost. Surface chemical treatments and watering can be accomplished with moderate to low costs, but frequent re-treatments are required for such techniques to be effective. Traffic controls, such as speed limits and traffic volume restrictions, provide moderate emission reductions, but it may be difficult to enforce such regulations on rural unpaved roads . . . Watering, due to the high frequency of treatments required, is generally not feasible for public roads and is effectively used only where watering equipment is readily available and roads are confined to a single site, such as a construction location.

Control of direct emissions from vehicles also can provide a modest amount of emission reduction. Some control is built into the use of catalytic converters as control devices in new vehicles, for converters rely upon unleaded fuel. Vehicles burning unleaded fuel are estimated to emit only 15 percent of the particulate matter that vehicles using leaded fuel emit. Additional reductions can be acheived by controlling heavy duty trucks (which emit three to four

times more particulate matter than cars burning leaded fuel) in certain parts of a city. Controls can also be achieved by pursuing stricter enforcement of visible emission regulations, and by reducing VMT.

Point Sources

Three major types of controls apply to this category:

- strict enforcement of existing emission limitations;
- adoption and enforcement of more stringent emission limitations for current unregulated or underregulated sources; and
- compliance by new sources with national or locally promulgated new source performance standards.

Emission limitations pertaining to fuel-burning installations could be tightened; limitations applicable to major oil-burning installations could be made specific for such units rather than coal-burning units; industry-specific process loss regulations could be developed; and source testing and surveillance activities could be increased.

Fuel Combustion

Relatively small fuel combustion units can be more completely controlled than currently is the practice by applying any of the following measures:

- assignment of more time and effort toward assessing and enforcing compliance of the larger of these sources with existing limitations;
- revision of existing emission regulations to require control or more stringent control on small combustion units;

- consumption of less fuel due to energy conservation efforts; and

- conversion of coal units to natural gas, or prohibition of new small coal-fired units (this technique, however, may conflict with current energy policy).

Whether or not this technique is workable or useful largely depends on the degree to which larger sources (point sources) are currently being successfully controlled.

Land Use Controls

Zoning and subdivision regulations can be viable tools for indirectly controlling emissions in at least four ways:

- by prohibiting certain types of development in non-attainment areas;

- by controlling the density of emissions in a given area (this assumes that subdivision and zoning regulations effectively implement the city's comprehensive plan and that the plan itself is beneficially related to air quality);

- by specifying the allowable density of emissions for a given zoning classification; and

- by specifying certain performance requirements for new developments (examples include requiring new subdivision roads and parking areas to be paved and existing parking areas to be paved by a certain date).

Air pollution considerations can also be injected into individual zoning decisions, but this process must be accompanied by a comprehensive approach to be effective.

SELECTION OF POTENTIAL STRATEGIES FOR FURTHER ANALYSIS

Not all of the strategies identified necessarily have to be part of a set of strategies (the scenario) which is

ultimately selected, and there are other strategies not discussed in this handbook which should be considered. The choice of strategies to include in the scenario will depend on the AQAC's evaluation of their air quality impacts, their costs, their social and political impacts, and so on. One method the subcommittee might consider as an aid in discussing strategies is a technique referred to as the Delphi technique. Using this method, the subcommittee could initially narrow the proposed strategies and choose some for further analysis.

This technique begins with the selection of a panel, in this case, the subcommittee.

1. Each subcommittee member is given some background material, probably this handbook and a copy of the AQMA analysis. (This should take place prior to a meeting of the subcommittee.)

2. At a subsequent meeting, each member is given a listing of potential control strategies and is asked to rank them separately in order of two criteria: expected impact on air quality and compatibility with local circumstances (e.g., availability of water, local governmental funding, etc.).

3. These questionnaires are given to the meeting organizer, who then has an assistant analyze the results. While the assistant is doing this, the members discuss their responses.

4. When the questionnaire has been analyzed, the results are reported to the subcommittee and again discussed.

5. The questionnaire is passed out again and members are provided with an opportunity to change their rankings in light of the views of other subcommittee members.

6. Upon completion, the questionnaires are again analyzed.

7. The results of this second process will be a ranking of the control strategies which the subcommittee wants to see analyzed in further detail.

SUGGESTED STRATEGY EVALUATION PROCEDURE

Evaluation of Selected Strategies

For each strategy which is selected for further study, PEDCo-Environmental will prepare analytical packages defining the nature of the existing control measure (if any), specifying the details of the proposed additional or modified measure, and estimating the air quality impact and financial cost associated with implementation of the proposed changes. These control packages will be given to the subcommittee for review and comment.

Specification of a Scenario for Comprehensive Analysis

Each subcommittee member will be provided with copies of control strategy packages. Shortly thereafter, the members will meet, discuss the adequacy of the control packages, consider the projected air quality impact of each strategy, and combine them into a scenario which they desire to have analyzed in detail.

Testing the Scenario

The scenario will be tested by revising the input to the diffusion model used in the AQMA analysis to reflect the changes in emission rates or spatial distribution of sources called for in the scenario.

In some cases, the control measures are such that it will not be possible to predict their effect with diffusion modeling. In these cases, it will be necessary to predict their effect on an individualized or microscale basis.

Optional Scenario

In the event that the selected scenario fails to achieve its objective, the results will be reported to the subcommittee. They will then be asked to select additional

control strategies for inclusion in their preferred scenario. This revised scenario will then be tested in the same manner as the first.

SUMMARY

When the process of identifying viable control strategies and determining the scenario is completed, there will be a draft air quality maintenance plan prepared for the Grand Junction area. The draft plan will then be considered by the full Planning and Management Region 11 Air Quality Advisory Committee for final approval and submission to the Colorado Air Pollution Control Commission. Responsibility for effecting this plan will be shared by the local and state governments. Implementation of the plan will attain and maintain the established air quality standards and preserve the natural beauty of the Grand Junction area.

APPENDIX A

CHARACTERIZATION OF PARTICULATE SOURCES INFLUENCING MONITORING SITES IN REGION VIII NON-ATTAINMENT AREAS

GRAND JUNCTION--CITY HALL
SAROAD Site No. 06-0980-010

Prepared by

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U.S. ENVIRONMENTAL PROTECTION AGENCY
Region VIII
Denver, Colorado 80203

June 1976

GRAND JUNCTION-CITY HALL
SAROAD Site No. 06-0980-010

Description

General site description - The sampler is presently located on the roof of City Hall (Fourth and Rood) in the commercial central business district about 15 feet above ground level. It is removed about 100 feet from the streets on two sides.

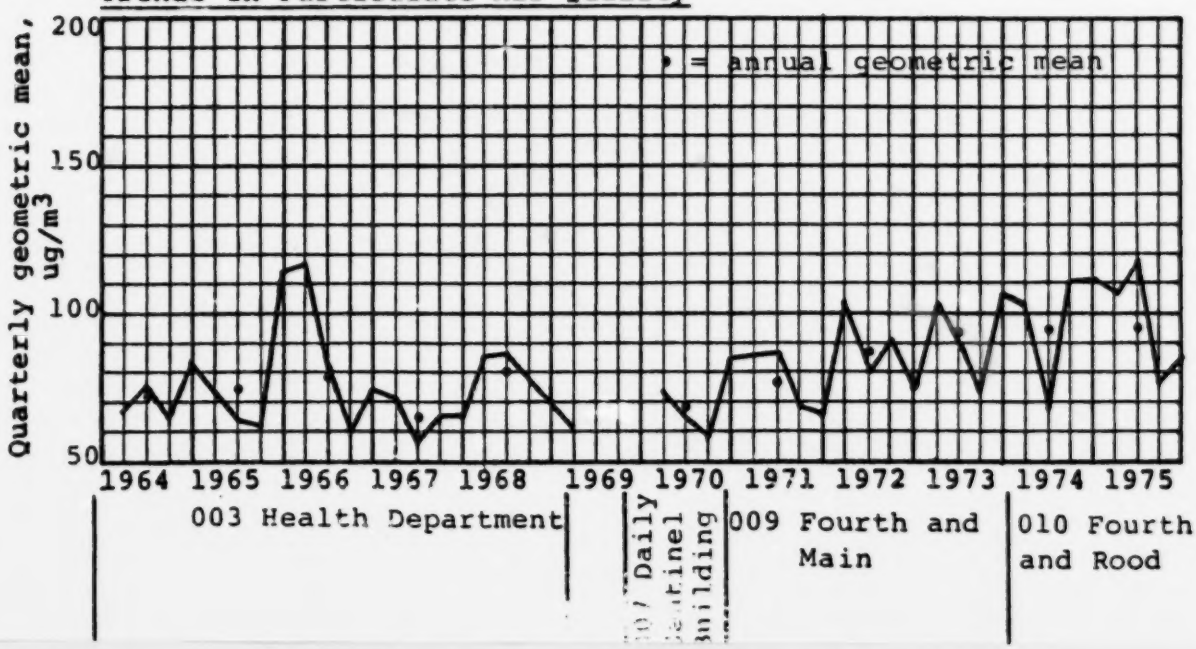
Localized pollution influences - There are no adverse influential sources in close proximity to the sampler with the exception of traffic in the central business district.

Physical interferences - There are no obvious obstructions near the sampler or tall buildings which would affect the readings.

Terrain - The area immediately surrounding the sampler is flat, as is the remainder of the 1 mile radius survey area down to the Colorado River, which borders the periphery of the area in the southwest quadrant.

Comments - In general, the area surrounding the sampler and the central business district is clean, while the north and south sectors of the survey area contain many cleared areas and unpaved parking lots. The sampler is probably situated in a good representative location. The sampler has been moved several times since 1964. The various locations are shown below on the graph.

Trends in Particulate Air Quality



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Grand Junction-City Hall.

Sources in Microinventory Area (1 mile radius)

Grand Junction — Population = 6,600; VMT = 116,600

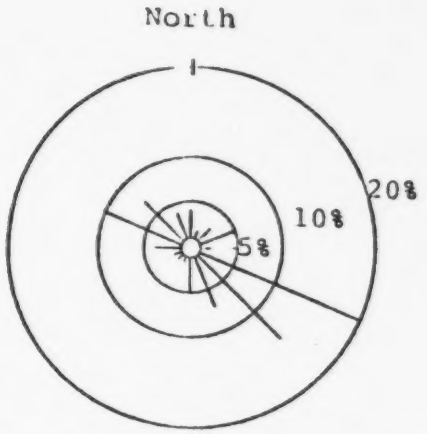
Source category	Size or activity rate	Emission factor	Partic emissions, ton/yr
Point sources:			
Whitewater Building Materials			neg
Mesa Feed & Farm Supply			1
Mix-Mill Feed Factory			neg
Area sources:			
Fuel combustion	From AQMA emission inventory report, 11.4% of county pop		22
Other mobile			4
Motor vehicle exhaust	116600 VMT/day	0.59 g/VMT	28
Fugitive dust sources:			
Unpaved roads	1.7 mi, 30 ADT	3.5 lb/VMT	33
Unpaved shoulders	10.6 ac	0.43 t/ac/yr	5
Paved roads	116600 VMT/day	3.5 g/VMT	164
Unpaved parking lots	21 ac	1.4 lb/VMT	12
Construction	6 ac	0.43 t/ac/mo	10
Cleared areas	210 ac	0.41 t/ac/yr	86
RR right-of-way	25 ac	0.5 t/ac/yr	12
RR yards	61 ac	0.5 t/ac/yr	30
Playgrounds	15 ac	0.43 t/ac/yr	6
Total emissions, ton/yr			413
Emission density, ton/sq mi/yr			131
Percent fugitive dust			87

Meteorological Data

Average annual
wind speed = 8.2 mph

Annual precipitation
1974 = 8.20"
1975 = 9.18"
Normal = 8.41"

No. of days
with precipitation = 90



Grand Junction Airport - 4% calm

Maximum Recorded Concentrations

1974 = 361 ug/m^3; 1975 = 522 ug/m^3

Summary and Conclusions

The Grand Junction site has been at four different locations during the past 12 years. Since 1971, annual mean concentrations have exceeded the primary standard every year and have shown a steady increase. The air quality data do not exhibit consistent seasonal variations. The present site location on the City Hall building seems to be representative of the urban area and free of local biases.

Major contributing sources identified by the microinventory were paved streets (40%), cleared areas (21%), unpaved roads (8%), and motor vehicle exhaust (7%). Point source contributions were less than one percent. The steady increase in ambient concentrations in recent years provides some confirmation of the major impact of the traffic-related emissions. While the estimated emission density of 131 ton/sq mi/yr does not appear adequate to generate an annual average concentration of 96 ug/m^3, this same relationship has been found at other western Colorado non-attainment sites such as Rifle and Steamboat Springs.

Reentrained dust from streets could be reduced by improved street cleaning and some other fugitive dust emissions could be reduced by more comprehensive enforcement of existing state regulations. The latter control measure would not require an SIP revision. It is possible that the combined effect of these two measures would still not result in attainment because of the low control efficiencies achievable for most fugitive dust sources.

APPENDIX B

AMBIENT AIR QUALITY STANDARDS

National ambient air quality standards were established in 1971 by EPA on the basis of the latest information available on the effects that air pollutants have on human health and welfare. Standards were specified for six pollutants including particulate matter, which is discussed in this handbook. Unlike the other air pollutants, particulate matter is not one substance or even a group of related substances. Much of the particulate matter is naturally occurring, and some size ranges and chemical components of particulate matter have been demonstrated to have more deleterious effects on human health than others.

Two classes of national air quality standards were designated: primary and secondary. Primary standards are designed to protect the public health. They have been reevaluated recently by the National Academy of Sciences and found to be set at a reasonable level to safeguard human health. The primary standard for particulate is 75 micrograms per cubic meter (ug/m^3) based on an annual geometric mean.* The second highest single reading during a year should not be greater than 260 ug/m^3 (this is the short-term primary standard).

Secondary standards are designed to protect the public welfare. They are meant to limit the effects of air pollutants on vegetation, materials, soil, water, and visibility in order to prevent economic damage. The secondary standards for particulate are 60 ug/m^3 annual geometric mean and 150 ug/m^3 not to be exceeded more than one reading per year.

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* A microgram is 10^{-6} gram or 2.2×10^{-9} lb. The geometric mean is a measure of central tendency often used with air quality data because it is not as readily distorted as the arithmetic mean by a few high values. It is usually about equal to the median value and is always lower than the arithmetic mean for a set of air quality data.

The State of Colorado has also established ambient air quality standards. The current State standards for particulate are 55 ug/m^3 annual arithmetic mean and 180 ug/m^3 not to be exceeded more than once per year. Presently, the Colorado Air Pollution Control Commission is reviewing these standards for possible revision in the near future.

Generally, mass measurements of air quality are taken on an instrument called a high volume sampler. This is an automated instrument that draws air through a filter inside the sampler. These filters are weighed to determine the mass of material in a known volume of air and may also be examined chemically or microscopically in a laboratory. The data gathered are compiled on a quarterly and an annual basis. Any average concentrations above the standard of 75 ug/m^3 indicate that harmful health effects may be occurring in the area sampled.

APPENDIX C

POINT AND AREA SOURCE PARTICULATE EMISSIONS, 1974

Table 1. POINT AND AREA SOURCE PARTICULATE EMISSIONS, 1974 (ton/yr)

Source Category	Mesa County	Grand Junction analysis area	Grand Junction non-attainment areas
Point sources	867	574	1
Area sources			
Fuel combustion:			
Bituminous coal	146		
Distillate oil	13		
Residual oil	9		
Natural gas	18		
LPG	4		
Wood	224		
Subtotal	414	338	22
Mobile sources:			
Highway	254	131	28
Off-highway	18	8	
Railroads	21	20	
Aircraft	1	1	
Subtotal	294	160	32[a]
Fugitive dust:			
Unpaved roads	24669	3833	50[b]
Sand on paved roads	474	251	
Paved roads	507	263	164[c]
Agriculture/cleared land	2223	1020	86
Land development	27	27	-
Construction	124	97	10
Quarrying, mining, tailings	80	85	-
Aggregate storage	51	31	-
Cattle feedlots	neg	-	-
Subtotal	28155	5657	358[d]
Other:			
Area process particulates	9	9	
Portable sources	14	8	
Forest fires/slash burning	26	-	
Agricultural burning	68	33	
Subtotal	117	50	-
Total	29847	6779	413

[a] this subtotal includes other mobile source emissions

[b] includes unpaved shoulders and unpaved parking lot emissions

[c] includes sand on paved roads

[d] this subtotal includes emissions from railroad right-of-way, railroad yards, and playgrounds